

PROTECTING PLANTS IN THE HOME YARD FROM INJURY BY THE JAPANESE BEETLE

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INTRODUCTION

Many people delight in growing flowers, shrubs, fruit, and vegetables in the home yard in the city, suburbs, and country. Unfortunately, from early spring until the approach of winter, these plants are constantly threatened with attack by insect pests and other enemies, and many times they are killed or their value is destroyed. One pest, the Japanese beetle, accidentally introduced into this country some years ago, feeds on many of the plants in the home yard in those parts of the country in which it has become established. The householder usually has little information on the protection of his plants from this pest. This circular is designed to present in brief the information necessary to enable the householder to prevent injury by the Japanese beetle to the various plants.

DISTRIBUTION OF THE BEETLE

The Japanese beetle, known to entomologists under the name of *Popillia japonica* Newman, is a native of Japan. It was first discovered in the United States in Burlington County, N.J., in the summer of 1916. The area of continuous infestation wherein general injury may occur comprises southern and central New Jersey, eastern Pennsylvania, northern Delaware, and the District of Columbia. Similar injury is also found locally in parts of Maryland. The beetle has also been found in several places in New England, New York, Ohio, Michigan, Virginia, West Virginia, North Carolina,

and South Carolina, but those captured in the more southern and western of these States may have been carried there by train or otherwise a short time before discovery and may thus not represent established infestations.

DESCRIPTION OF THE BEETLE

The adult Japanese beetle has a very distinctive appearance. It is a brightly colored insect, broadly oval, and about three-eighths of an inch long. It is a brilliant metallic green, except for the greater part of the wing covers, which are reddish bronze. On the sides and tip of the abdomen are 12 tufts of hairs which resemble small white dots (fig. 1).

The immature form of the beetle, commonly referred to as the grub or larva, resembles in general appearance the native white grubs. The grubs vary in size from tiny, recently hatched individuals to those nearly 1 inch long. They are white, with a bluish or blackish cast, which is especially prominent at the rear end, and with a tan-colored head. They are found in the soil, curled characteristically in the form shown in figure 2.



FIGURE 1.—The adult Japanese beetle.
About 4 times natural size.

NATURE OF ITS INJURY

The adult Japanese beetle has chewing mouth parts. In general, it consumes the tissue between the veins of the leaves and also eats portions of the blossoms and the fruit. The leaves are skeletonized wholly or in part (fig. 3), and the remnants of these leaves soon turn brown and fall. The beetle prefers to feed on the portions of the plant exposed to the direct rays of the sun. It usually begins to feed on the upper and outer portions and works downward and inward. When infestation is severe, even large shade trees may be completely defoliated within a few days.

The beetle feeds on a large number of plants. It has a marked preference for the foliage and fruit of apple, peach, plum, quince, cherry, raspberry, and blueberry, and the foliage of grapes. Among the shade trees, it is especially fond of linden, chestnut, horsechestnut, sassafras, and elm. The beetle is likely to injure such ornamentals as flowering cherry, flowering quince, flowering peach, spirea, hawthorn, shrub-althea, rose, hollyhock, dahlia, zinnia, hibiscus, and Virginia creeper. In the vegetable garden it has a marked preference for the silk of corn and feeds on the foliage of beans.

The larvae feed on the roots of grasses and legumes, and occasionally they attack the roots of iris, peony, gladiolus, snapdragon,



FIGURE 2.—The grub, or larva, of the Japanese beetle. About 5 times natural size.

calendula, and other ornamental plants and shrubs. They have been known to feed on the roots of strawberry, corn, bean, tomato, beet, onion, and other vegetable crops. The most serious injury by the larvae is to the roots of grass.



FIGURE 3.—Grape leaf showing injury by the Japanese beetle.

The appearance of a lawn suffering from injury by these larvae is similar, in the early stages, to that of a lawn retarded by an inadequate supply of moisture or nutrients. If a portion of the sod is examined and a large number of larvae are found, one may be certain that these larvae are causing the damage. As the injury becomes more extensive, the aerial portion of the grass is often completely severed from the roots. Turf which has been killed in this manner, as shown in figure 4, can be rolled back easily by the fingers.

In the latitude of Philadelphia the beetles begin to emerge and feed about the middle of June and are usually most numerous and destructive during the last part of July and the first part of August.

COOPERATION ESSENTIAL IN CONTROL MEASURES

The gardeners of a community should cooperate by controlling the Japanese beetle on their own premises and by encouraging and assisting those not yet converted to the use of control measures against this insect. During the summer months, within the area of continuous infestation, the Japanese beetle is present in enormous numbers. The efforts of the individual, without cooperation of his neighbors, may be of little avail against this beetle.

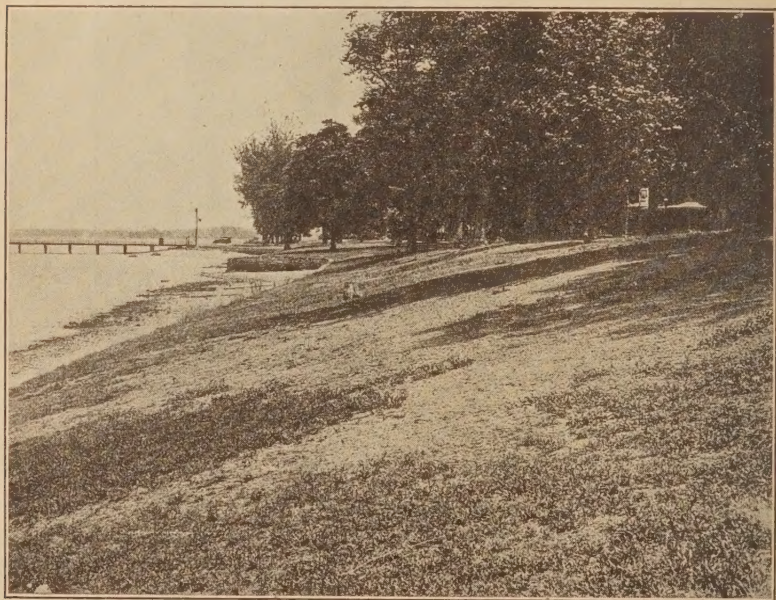


FIGURE 4.—A lawn injured by larvae of the Japanese beetle.

PLANTING PLANS

Under some conditions the most practicable plan for the control of insects is to select for planting those species of plants that are not subject to attack. This cannot always be done, but where a choice is possible, it is wise to choose trees, shrubs, and other ornamentals that are known to be immune or practically immune to severe injury by the adult Japanese beetle. The following plants have been observed to be injured only to a slight extent, or not at all, by this insect. The list, although not complete, is offered as a suggestion.

Fruits: Dewberry, gooseberry,¹ and pear.

¹ Owing to the fact that currant and gooseberry plants propagate and spread the white pine blister rust, the Department recommends against the planting of these bush fruits within 900 feet of white pines and other 5-leaved pines.

Vegetables: Cabbage, carrot, cauliflower, eggplant, lettuce, onion, parsley, parsnip, pea, potato, radish, spinach, squash, sweetpotato, tomato, and turnip.

Ornamental garden plants: Calendula, carnation, chrysanthemum, columbine, coreopsis, cosmos, four-o'clock, gladiolus, goldenglow, iris, larkspur, lily, nasturtium, pachysandra, pansy, peony, petunia, phlox, poppy, snapdragon, sweet pea, tulip, and violet.

Ornamental vines: Clematis, English ivy, honeysuckle, and wisteria.

Ornamental shrubs and trees: Ash, arborvitae, azalea (except deciduous varieties), beautyberry, beech, box, catalpa, chamaecyparis, cypress, deutzia, dogwood, euonymus, fir, forsythia, goldflower, hemlock, hydrangea, juniper, lilac, locust, maple (except Norway maple and Japanese maple), mockorange, oak, pearlbush, pine, poplar, privet, rebud, rhododendron, snowberry, spirea, spruce, sweetgum, tupelo, and weigela.

TRAP PLANTS OF LITTLE VALUE

It has been observed that in early August, after the height of the beetle season, the beetles may feed to some extent on certain species of geranium (*Pelargonium* spp.) and castor-bean (*Ricinus* spp.) and on the silverbell tree (*Halesia carolina*) and die as a result of the feeding. None of these plants are sufficiently attractive to the beetle to induce the insect to leave favorite food plants in the immediate vicinity. On the basis of the present information, these plants are of little value in controlling the beetle under usual field conditions.

REDUCING THE NUMBER OF BEETLES ON THE PREMISES

Any method which is effective in reducing the number of beetles on the premises affords some protection to the plants. These methods should not, however, be used alone but in conjunction with other measures for the protection of plants.

BY JARRING

One of the easiest methods for destroying beetles on heavily infested plants is to shake the plants before 7 a.m. when the temperature is low and the beetles are sluggish. The beetles fall to the ground when a plant is jarred under these conditions. Sheets may be spread under the plants to catch the beetles, which may be killed by placing them in a bucket containing water and kerosene.

BY CONTACT SPRAYS

Japanese beetles can be destroyed by a spray which kills by contact. One of the most satisfactory sprays of this type is composed of sodium oleate and an alcoholic extract of pyrethrum flowers diluted with water. Several proprietary sprays containing these ingredients are on the market, and, when used according to the directions, are satisfactory. In the absence of these sprays, commercial fish-oil soap or one of the household soaps may often be used effectively when only a few plants are to be treated. Common soap should be employed on plants in foliage in the proportion of 1 pound to from 3 to 4 gallons of water, less water being used if the soap contains much moisture or if the water is hard. It is generally possible to make 2 or 3 applications of these sprays to the harder plants without causing injury, but continued use of any sprays containing soap is likely to cause some injury to foliage.

The effectiveness of a contact spray against the Japanese beetle depends mainly upon the thoroughness with which the insect is wetted. Satisfactory results cannot be obtained unless the insect is completely covered. A few drops of spray on a beetle are not sufficient to kill it. A coarse drenching spray should be used to wet the beetles thoroughly.

The beetle is most susceptible to contact sprays between 10 a.m. and 4 p.m., when the sun is shining, the temperature is above 80° F., and the relative humidity is comparatively low. As the beetles are active and easily disturbed under these conditions, the spray must be applied quickly to drench them. When the weather is cool, or the sky is overcast, or rain is falling, the beetle is not easily killed by contact sprays. It is practically futile to attempt to use these sprays under adverse weather conditions.

The contact spray can be applied to large trees and shrubs only by means of a large power sprayer, operating at a pressure of 250 to 500 pounds to the square inch. If the householder lives in a community where there is a municipal department or civic organization equipped with such a sprayer, it usually is possible to have the large trees and shrubs sprayed at a minimum cost. If there is no such local department or organization with available spraying service, a commercial spraying concern may be engaged. The spray can be applied to low-growing plants in a satisfactory manner by means of one of the hand-power sprayers for general use in gardens (fig. 5).

Contact sprays, properly applied, will kill a large number of beetles on the foliage at the time of application, but the use of such sprays will not prevent the plants from becoming reinfested and subsequently injured. The beetle is a strong flier and moves readily from one plant to another. The usefulness of a contact spray against the Japanese beetle is limited to reducing the number of beetles on the premises.

BY TRAPS

Many millions of beetles have been captured annually since 1925 in mechanical traps. This is an easy and inexpensive method for destroying large numbers of this insect. Many types of traps are sold commercially for this purpose; the most satisfactory results, however, have been obtained with traps similar in construction to the one shown in figure 6. The beetles are attracted to the traps by a mixture of 10 parts of geraniol and 1 part of eugenol, which has been found to be more attractive to this insect than any other material known. The bait can be obtained in a solid or liquid form. Bait and traps of the type recommended here are sold at many garden-supply establishments in New Jersey, eastern Pennsylvania, and northern Delaware.

The attractive power of the trap is governed by the atmospheric conditions. Air currents are necessary to carry the attractive vapors. In residential sections, where trees and buildings tend to deflect or impede the movement of air currents, the area of attraction is comparatively small. The larger the number of traps employed in a given area, the greater will be the effect on the beetles in the vicinity. The traps should be placed where the wind will carry the odor of

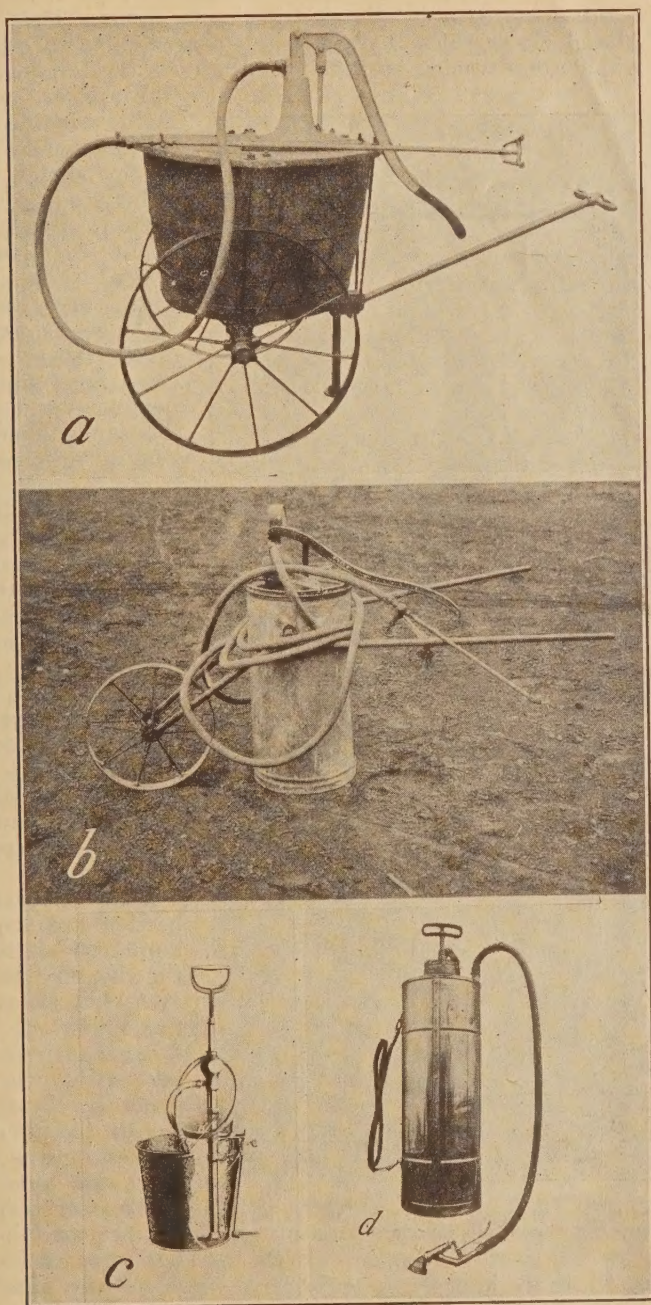


FIGURE 5.—Hand-power sprayers for general use in gardens: *a*, Two-wheel type; *b*, one-wheel barrow type; *c*, bucket pump; *d*, compressed-air type.

the attractants and draw the beetles from the plants. They should not be placed closer than 10 feet to the nearest plants; otherwise beetles which are attracted are likely to alight on the foliage.

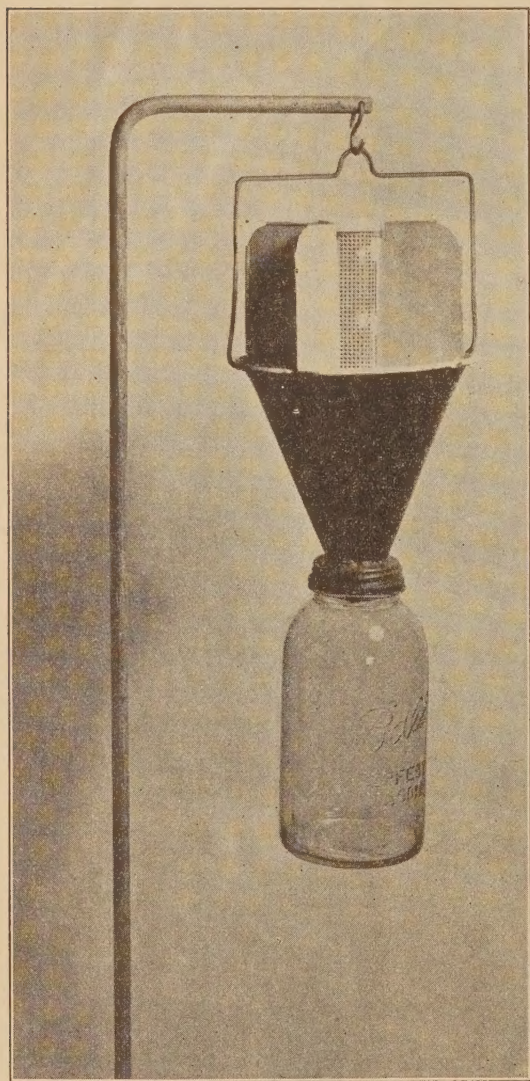


FIGURE 6.—Japanese-beetle trap. The beetles, attracted to the bait, fly to the trap, strike the baffle plates, and drop through a funnel into the glass jar below.

Traps are particularly valuable in localities where there are few beetles. There is little danger of injury to plants as a result of their use under these conditions, and each female beetle captured under these conditions is of more importance than several thousands taken in the heavily infested districts. As each female beetle may lay as many as 40 eggs in one season, it is apparent that the consistent use of traps in lightly infested localities, especially when these are removed some distance from the area of continuous infestation, will be of great value in preventing the rapid increase in the number of beetles.

Many thousands of beetles are captured annually by traps in the heavily infested area, but because of the influx of beetles from the surrounding properties there is generally little reduction in the number of beetles on the premises. In some cases the use of traps has not increased the number of beetles on the

premises, while in other cases traps have increased the number of beetles. This variation in the effect of the traps is caused to a large extent by the conditions under which they are used. Within the

heavily infested area, traps cannot be depended upon to protect favored food plants from attack by the Japanese beetle.²

PROTECTION OF SHRUBS AND ORNAMENTALS

PROTECTION OF NONFLOWERING PLANTS

It is possible to protect the foliage of ornamental plants by maintaining a deposit of spray residue on all portions of the plants subject to attack, during the period when the beetles are flying. The spray residue largely repels the beetle and prevents extensive feeding, the protection being obtained primarily by making the plant non-attractive rather than by poisoning the beetle.

Timeliness and thoroughness in the application of repellent sprays are very important. As a general rule, especially in localities where the beetles are very numerous, the first sprays should be applied when the beetles begin to appear in the vicinity, before they become established on the plants. In localities where the infestation is not dense, the first application may be delayed until the beetles begin to appear on the plants to be protected. However, in the heavily infested localities it is often difficult to prevent injury if the spraying is delayed until beetles appear on the plants.

For the protection of large trees and shrubs, the householder should have the protective spray applied by means of a locally owned high-pressure sprayer or a commercially operated sprayer of the type now in general use for the control of insects. When the plants are small the protective spray can be applied by the householder, one of the hand-power sprayers shown in figure 5 being used. The most satisfactory protective spray for use by the householder is made by adding 1 pound of hydrated lime to 3 gallons of water. As the residue is washed off by the rain, and the leaves developing subsequent to spraying have no protective coating, it may be necessary to make several additional applications to obtain adequate protection throughout the season.

PROTECTION OF FLOWERING PLANTS

No satisfactory spray has been found for the protection of flowers highly attractive to beetles, as it is not possible to keep the unfolding bloom covered with a protective residue. The presence of a white residue on a flowering plant, such as a rose, destroys the beauty of the blooms. To a lover of flowers, the discoloration of the blooms is almost as objectionable as the destruction of the plant. The beetle begins to attack the rosebud when the sepals separate sufficiently to show the color of the petals. If the buds are removed at this stage, the rose will not be faded by the sun and will be more satisfactory for indoor display. Individual flowering plants, or groups of plants, can be protected by enclosing them with a cloth or wire netting. Frames for holding the netting can be constructed of wood or metal at moderate cost. Several growers of choice roses have successfully protected their flowers by this method. When the

² For a more complete discussion of the use of traps, see the following publication: METZGER, F. W. TRAPS FOR THE JAPANESE BEETLE AND HOW TO USE THEM. U. S. Dept. Agr. Misc. Pub. 201, 12 pp., illus. 1934.

plants are protected in this manner, it may be necessary to apply a fungicide during July and August, because the enclosed plants appear to be more subject to mildew than plants grown in the open.

PROTECTION OF VEGETABLES

Sweet corn is the only vegetable garden crop that is severely injured by the adult beetle. The chief injury to corn results from the feeding of the adult beetles on the silk as it grows from the husk, before pollination has occurred. Since the destruction of the green immature silk prevents pollination, the prevention of injury to corn is dependent upon protecting the silk from attack until pollination has taken place.

Corn can be protected by dusting the tips of the ears with very fine (300-mesh) hydrated lime when the plants begin to show silk,

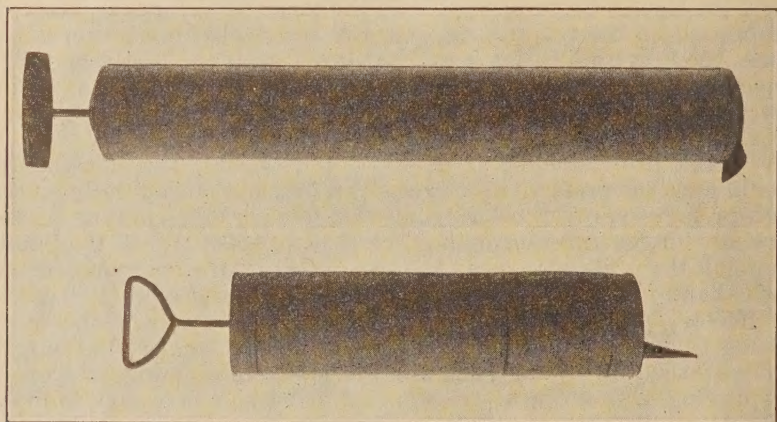


FIGURE 7.—Types of small hand dusters suitable for backyard gardens.

using a hand duster similar to those shown in figure 7. The application should be made before the beetles begin to accumulate on the ears. Following the first application, at least two additional applications should be made at intervals of 3 days. The effectiveness of this treatment depends almost entirely upon placing the lime at the proper time on the tips of the ears; the need of extreme care in the application cannot be overemphasized.

The foliage of string and lima beans is occasionally damaged by the Japanese beetle. The foliage can be protected by spraying with 1 pound of hydrated lime in 3 gallons of water, or by thoroughly dusting with lime.

PROTECTION OF FRUIT

SMALL FRUITS

There is no satisfactory procedure for protecting raspberries, blackberries, and blueberries from injury until after the fruit is harvested. It is practically impossible to remove the spray residue from these berries without damaging them. After the fruit is picked, the foliage can be protected by applications of lime.

GRAPES

Bearing and nonbearing grapevines can be protected by spraying with 1 pound of lime in 3 gallons of water. The Japanese beetle does not feed on the fruit. The spray should be directed downward from above to avoid excessive residue on the fruit at the time of harvest, but every leaf should be covered. Additional applications of the spray are usually necessary to protect the new growth that develops subsequent to the initial spraying.

TREE FRUITS

It is practically impossible for the householder to spray the foliage of fruit trees thoroughly with the ordinary garden spraying equipment. When there are several fruit trees to be sprayed, it would be advisable to arrange with a local department, civic organization, or commercial orchardist to apply the different sprays required to protect the fruit from insects and disease. It is practically impossible to protect apples and peaches that ripen during July and early August from attack by the Japanese beetle. The ripper fruit is attacked first by the beetles, and when the infestation is relatively light the damage may be confined to these ripper fruits. The cherry crop is usually harvested before the beetles appear in sufficient numbers to cause damage to the fruit. Small power sprayers suitable for spraying fruit trees are on the market. When the householder has such equipment, he can protect late apples, late peaches, plums, and the foliage of cherry trees after harvest, by spraying the trees thoroughly with 1 pound of lime in 3 gallons of water.

PROTECTION OF LAWNS

It is possible to make an established lawn practically immune to injury by larvae of the Japanese beetle by applying commercial acid lead arsenate. It is better to prevent injury to the grass by applying the poison before the density of the larval population is sufficient to cause damage, but if this has not been done, treatment should be made as soon as injury becomes apparent. This material can be applied at any season when the ground is not frozen, but the best results are obtained if it is applied before July. An application of lead arsenate at the rate of 5 pounds to 1,000 square feet before the adult beetles appear has been found to reduce an infestation of 100 to 150 larvae per square yard so that damage did not occur; when the infestation is heavier, it is advisable to use the material at the rate of 10 pounds, or even 15 pounds, to 1,000 square feet.

In some localities the householder can secure mixtures of lead arsenate and organic fertilizers that are prepared for the control of these larvae in grass. When these mixtures are not available, the commercial acid lead arsenate, in powder form, can be used. These small quantities of lead arsenate must be diluted to a greater bulk in order to obtain a uniform distribution over the surface. The material may be mixed with about 25 times its volume of moist sand, soil, or other suitable material, and broadcast by hand. The commercial mixtures may be applied more uniformly by means of one of the distributors shown in figure 8.

Lead arsenate is poisonous to man and animals. Considerable care should be exercised in handling it in order to avoid inhaling the dust. It may be mixed and otherwise manipulated with the bare hands, but, since it is possible that the poison may be absorbed into the system through cuts and abrasions of the skin, it is advisable to protect the hands. The worker should keep the hands away from the mouth and wash them thoroughly before eating. It is advisable that children be kept from playing on the recently poisoned turf until the lead arsenate has been removed from the blades of grass by rain or wind. The extensive use of lead arsenate on lawns within the heavily infested area has not caused any known damage to poultry or native birds which feed on earthworms and grubs in the soil.

It is to be expected that a lawn treated in this manner will be immune to injury by the larvae for several years.³



FIGURE 8.—Distributors for spreading acid lead arsenate on grass.

CONTROL OF THE LARVAE IN FLOWER BEDS AND GARDENS

The larvae of the Japanese beetle are generally not sufficiently numerous in flower beds and vegetable gardens to cause appreciable damage to the roots of the plants. Occasionally the roots of flowering plants such as calendula, rose, dahlia, peony, and snapdragon, and garden crops such as strawberry, beet, onion, and bean, are injured.

The use of acid lead arsenate is not recommended in flower beds, shrubbery borders, or vegetable gardens, as the available evidence shows that some of the ornamentals will not grow in soils containing this material. Many of the vegetables will grow in land treated with lead arsenate, but enough of the poison may be absorbed by the roots to be detrimental to health.

When the infestation is heavy enough to warrant treatment, the larvae can be destroyed by applying carbon disulphide emulsion to

³ For further information on the treatment of lawns for protection against this insect see the following publication: FLEMING, W. E. and OSBURN, M. R. CONTROL OF LARVAE OF THE JAPANESE AND THE ASIATIC BEETLES IN LAWNS AND GOLF COURSES. U. S. Dept. Agr. Circ. 238, 11 pp., illus. 1932.

the soil. The most satisfactory carbon disulphide emulsion for use by the householder is composed of—

	<i>Parts by volume</i>
Rosin fish-oil soap-----	1
Water-----	3
Carbon disulphide-----	10

The soap and water are placed in a closed container and agitated until the mixture is uniform. The carbon disulphide is added and the agitation continued until the mixture becomes creamlike. One quart of this mixture is added to 50 gallons of water and applied to the infested ground at the rate of 3 pints to a square foot of surface. For small areas this liquid may be applied with an ordinary sprinkling can.

CAUTION.—Carbon disulphide is a dangerous chemical. The vapor when mixed with air is inflammable. It should be kept away from fire of all kinds. Lighted cigars, cigarettes, or pipes should never be carried when handling this material. Exercise the same caution as when handling gasoline.

Turning the soil late in fall, or carefully working it in the spring and killing the larvae that are found, or permitting chickens to run in the garden until seeding time, are also useful in reducing the number of larvae in the garden.

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